Noiseless Near-Infrared Photon Counting Avalanche Photodiode Detectors

Completed Technology Project (2013 - 2017)

Project Introduction

This proposal concerns the research and development of a mercury cadmium telluride (HgCdTe) Avalanche Photodiode (APD) array for use as a low-noise science detector in optical and near-infrared (O/NIR) instruments and observatories, and is specifically an application for a NASA Space Technology Research Fellowship to accelerate this project and enable greater graduate student involvement. Prototypical 32 x 32 APD arrays currently in production at Raytheon Vision Systems (RVS) will be commissioned and characterized at the Institute for Astronomy (IfA) in Hilo, Hawai'i. Commissioning will require developing and adapting an interface for detector operation, and characterizing will be accomplished in existing cryogenic platforms. The arrays will also be given trial runs using the astronomical facilities on Manua Kea, including the University of Hawai'i 2.2m telescope and the Canada-France-Hawai'i Telescope. Following validation of the prototype arrays, the RVS -IfA collaboration will upscale production to large-format megapixel APD arrays, design and implement long-term control and operation schemes, and begin incorporation of the arrays into upcoming instrument designs. The avalanche signal amplification of these HgCdTe APD arrays produces effectively noiseless signals useful for astronomical observations, and will likely see deployment in both ground- and space-based telescopes. Near-infrared photon counting is unprecedented and will permit observations that previously required excessive observation times, particularly with regards to dim photon-starved targets. The wavelength versatility of HgCdTe from the visible to 5-micron-plus makes these devices suitable for a broad range of applications, and their deployment is expected to be revolutionary for observational astronomy.

Anticipated Benefits

The avalanche signal amplification of these HgCdTe APD arrays produces effectively noiseless signals useful for astronomical observations, and will likely see deployment in both ground- and space-based telescopes. Near-infrared photon counting is unprecedented and will permit observations that previously required excessive observation times, particularly with regards to dim photon-starved targets. The wavelength versatility of HgCdTe from the visible to 5-micron-plus makes these devices suitable for a broad range of applications, and their deployment is expected to be revolutionary for observational astronomy.

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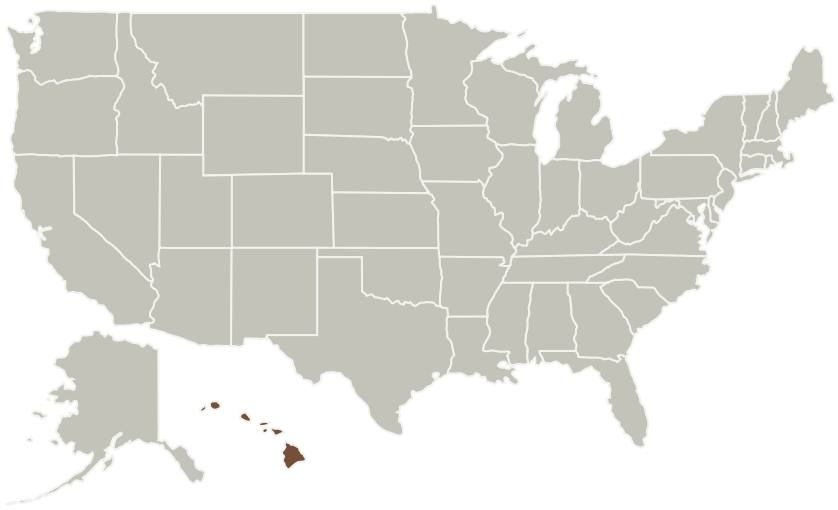
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Hawaii Maui College	Lead Organization	Academia Asian American Native American Pacific Islander (AANAPISI)	Kahului, Hawaii

Primary U.S. Work Locations
Hawaii

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

University of Hawaii Maui College

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

Donald E Hall

Co-Investigator:

Dani E Atkinson

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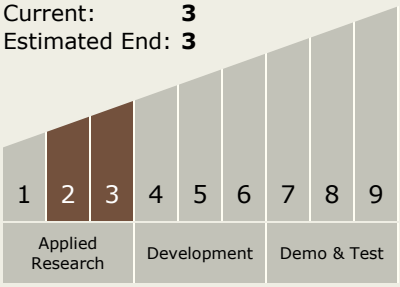
Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System